ORIGINAL ARTICLE

Epidemiology of burn injuries in South-Eastern Iran: A retrospective study

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Abstract

Objective: To explore the epidemiology of burn injuries in Zahedan, Southeastern Iran.

Methods: A retrospective review of 730 medical records, of burnt patients, for a period of two years was done. Pre-designed data recording forms were used to collect data. The SPSS-15 was used to analyze data.

Results: Overall, 713 medical records were analyzed: two-thirds (62.0%) were fire-related and one-third related to scalds (33.1%). Intentional self-harm injuries accounted for 14.3% of all admissions. A significant difference existed between patients' age or sex and the causes of burns (P<0.001). Burns more than 60% closely correlated with death rate and hospital stay (P<0.001).

Conclusion: Lack of the necessary, socio-economic infrastructure, language and cultural barriers, low level of literacy, flammability of women's clothes and unsafe application/design of stove and heaters are likely to contribute to the high frequency of burn injuries in this area.

Keywords: Burn, Epidemiology, Intentional, Iran, Unintentional. (JPMA 63: 1476; 2013)

Introduction

Despite considerable advances in medical care, including infection control, burns still represent one of the most leading causes of death and injury in low- and middle-income countries. According to the International Society for Burn Injuries (ISBI), a burn is a type of injury that occurs within some or all of the different layers of cells in the skin, and is caused by a hot liquid (scald), a hot solid (contact burns) or a flame (flame burns). Any damage to skin from ultraviolet radiation, radioactivity, electricity or chemicals, as well as respiratory damage resulting from smoke inhalation, are also considered to be burns.[1] Similarly, World Health Organisation (WHO) has classified burn injuries as those caused by exposure to smoke, fire and flames, contact with heat and hot substances, exposure to electric current, lightening and exposure to corrosive substances. Sunburn and radiation-related disorders of the skin and subcutaneous tissue are not included in this classification of burns.[2]

Burn injuries continue to contribute significantly to the global burden of disease. They account for over 310,000 fire-related unintentional deaths each year, largely among children and young adults (aged 5-29 years). In addition, there were over 7.1 million fire-related accidental burns in 2004, giving an overall incidence rate of 110 per 100,000 per year. According to WHO, the incidence rate in low- and middle-income countries is 1.3 compared to 0.14 per 100,000 population in high-income countries. The incidence in the WHO's Eastern Mediterranean Region (EMR) is 29 per 100,000 per year compared to the lowest incidence in the Americas which was 8, and the highest incidence in South East Asia which was 186 per 100,000 per year. Over 95% of fatal fire-related burn injuries occur in low- and middle-income countries.[2-4]

Contrary to the trend in EMR countries, Iran has a high incidence of burn injuries, either intentionally or unintentionally.[4] Recent studies on injuries show that burns are one of the leading causes of unintentional home-related injuries in Iran, accounting for 40% of those injuries across all age groups. A high proportion of these burn injuries have been reported among females. Further, Iran exceeds other EMR countries in terms of hospital in-patient mortality and length of stay (LoS) due to burn injuries. While, for example, a Kuwaiti study reports an annual burn mortality rate of 0.6 per 100,000 across all age groups,[5] two Iranian studies have found a much higher mortality rate of 4.6 and 5.6 per 100,000 per year.[6,7]

In addition, the socio-economic status and trends of burns pose significant burden on societies, families, governments and healthcare systems, even though little data exists to show this trend in low- and middle-income countries. For example, the minimum direct medical cost for each hospitalised, burn patient is estimated to be $3000-5000 in the United State. The social impact of burns

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e.g. lost workdays would further inflict on health sectors.[8]

Despite the growing number of published studies on aetiology and epidemiology of burn injuries in Iran, very little is known about such a problem in different parts of Iran, its nature and extent. Previous studies have concentrated at a single hospital unit e.g. emergency department or specific sample groups e.g. females or children, ignoring multiple factors that cause burn injuries in various areas. The aim of this study was to identify the epidemiology of burn injuries in patients at a hospital in southeastern Iran. It was conducted to add crucial dimensions to our understanding of public health policies.

Patients and Methods

The hospital-based, cross-sectional retrospective study was conducted at Khatam Hospital, a tertiary healthcare centre in Zahedan, which is the capital of Iran's Sistan-e-Baluchistan province with a population of around 2.4 million living over 181,785 square kilometres of land. The hospital is the sole burns centre in the city and receives all major burn injuries from across the province. The study comprised retrospective review of the medical records of all burns patients who had been admitted to the hospital from March 2008 to late February 2010. The study was approved by the Human Research Ethics Committee of the Zahedan University of Medical Sciences. Pre-designed forms were used to collect data regarding the patients' demographics (e.g. age and gender), type of burns, number of admissions and discharges, place of occurrence of injury, Total Body Surface Area (TBSA) burnt, degree of burn injury, average LoS in hospital, underlying cause, grade and anatomical site of the burn, and patient outcome. Relevant data was retrieved from the patients' medical record folders independently by two trained reviewers under the supervision of the main investigators. Burn injuries involving two or more parts of the body were automatically classified as cases of multiple injuries. No burn patient was excluded from the study.

SPSS 15 was used to analyse the data. Chi square test was used to compare categorical data, and to test associations among variables. Besides, t-test and analysis of variance (ANOVA) were used to compare the mean values of various continuous variables in different groups/categories. The significance level was set at 0.05.

Results

A total of 730 records were analyzed and 17 (2.3%) had to be excluded for incomplete data. The final sample size was 713. Of them, 387 (54.3%) patients were male, giving an overall male-female ratio of 1:13. The mean age of the patients was 19.8±14 years, (95% CI: 18.8-20.9) with a range of 1 to 85 years. The majority of the admissions 307 (42.6%) were in the 20-39 year age group, followed by 10-19 years 141 (20.0%). Infants (<2 years), children (2-9 years old) and older adult (>40 years) burn admissions were 12.5%, 15.6% and 9.4% respectively.

With respect to marital status, 51.5% (n=367) of the patients were single, 27.9% (n=199) were married, and the remainder showed no record of marital status (n=147, 20.7%). Most of the burn injuries had occurred at home (n=642; 90.0%), followed by patients' places of work (n=39; 5.5%) and other outdoor locations e.g. freeways or streets (n = 31; 4.4%).

Nearly two-third of the injuries (n=438; 62.0%) were fire-related in nature; one-third were scalds/liquid/fluid/vapour burns (n=236; 33.1%); while only 24 (3.4%) admissions were due to electrical accidents, and 6 (0.8%) admissions were on account of chemical burn scalds. Most of the burn injuries were unintentional: scalds including hot water and gas explosion were the most common causes of burn in our series and comprised 25.5% (n=180) and 23.4% (n=165) of all admissions, respectively. Intentional self-harm injuries (suicides) accounted for 14.3% (n=101) of all admissions in both genders (Table-1). Other causes of burn injuries

Table-1: Distribution of patients by gender and cause of burn injuries.

Cause of Burns	Number of Patients					
	Males		Females		Total	
	N	%	N	%	N	%
Self-inflicted	31	30.7	70	69.3	101	100
Gas Explosion	79	47.9	86	52.1	165	100
Oil-filled Heater (kerosene)	27	41.5	38	58.5	65	100
Electrical	24	100.0	0	0.0	24	100
Scald/Hot Water	99	55.0	81	45.0	180	100
Other causes	124	72.9	46	27.1	170	100
Total	384	54.5	321	45.5	705	100

Table-2: Distribution of patients by age and cause of burn injuries.

Age (Years)	Less than 2		2-9		10-19		20-39		40 and More		Total	
Cause of Burn	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Self-inflicted	0	0.0	0	0.0	36	35.6	62	61.4	3	3.0	101	100
Gas Explosion	11	6.7	12	7.3	29	17.6	88	53.3	25	15.2	165	100
Kerosene Heater	2	3.1	6	9.2	16	24.6	33	50.8	8	12.3	65	100
Electrical	0	0.0	4	16.7	1	4.2	18	75.5	1	4.2	24	100
Scald/Hot Water	67	37.2	67	37.2	16	8.9	23	12.8	7	3.9	180	100
Other causes	8	4.7	21	12.4	43	25.3	76	44.7	22	12.9	170	100
Total	88	12.5	110	15.6	141	20.0	300	42.6	66	9.4	705	100
P-value						**P <0.001**						
Death rate	7	8.1	5	4.7	44	32.1	92	31.9	11	18.3	159	100
P-value						**P <0.001**						

Table-3: Distribution of patients by TBSA burned and causes of burn injuries.

%TBSA	Percent TBSA Burned								Total	
	0-20%		20-40%		40-60%		60-100%			
Causes of Burns	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Self-inflicted	1	1.0	2	2.0	10	9.9	88	87.1	101	100.0
Gas Explosion	50	30.3	49	29.7	26	15.8	40	24.2	165	100.0
Kerosene Heater	17	26.2	11	16.9	19	29.2	18	27.7	65	100.0
Electrical	14	60.9	7	30.4	2	8.7	0	0.0	23	100.0
Scald/Hot Water	111	61.7	48	26.7	13	7.2	8	4.4	180	100.0
Other causes	73	43.2	45	26.6	22	13.0	29	17.2	169	100.0
Total	266	37.8	162	23.0	92	13.1	183	26.0	703	100.0
P-value					**P <0.001**					
%TBSA Death rate	2	0.8	5	3.1	19	20.7	133	72.3	159	100.0
P-value					**P <0.001**					

TBSA: Total Body Surface Area.

included cooking-related scalds (i.e. oven burns and food water), tar burns as well as motorcycle exhaust burns, being together responsible for 170 (24.1%) cases.

Burn-related injuries varied across age groups and gender. There was a significant difference between gender and causes of burns (X2=73.77, df=5, P<0.001). Intentional self-inflicted burns 70 (69.3%), oil-filled heater 38 (58.5%) and gas explosion 86 (52.1%) were the leading causes of injuries in females, while scalds, including hot water, 99 (55.5%) were the main cause among males.

A statistically significant difference was also found between patients' age groups and the cause of burns, with electrical injuries 18 (75.5%), suicidal burns 62 (61.4%), gas explosion 88 (53.3%) and kerosene heaters 33 (50.8%) being more common among patients aged 20-39 years old (X2=308.37, df=20, p <0.001). Hot water burns occurred predominantly in the age groups 2-9 years 67 (37.2%) and children less than two years old 67 (37.3%). Nearly all self-inflicted burns occurred in age groups 20-39, 62 (61.4%) and 10-19, 36(35.6%) years old. However, 134 (74.4%) of burns caused by hot water were attributed to age groups less than 9 years old. In addition, burn injuries due to gas explosion, kerosene heater and electricity were found more in the age group of 20-39 years old (Table-2). Females were prominently more vulnerable to self-inflicted burns than males 70 (69.3%) vs. 31 (30.7%). Likewise, women were more at risk of getting burnt by kerosene heaters compared with men 38 (58.5% vs. 41.5%).

Further analysis revealed that a significant difference existed between patients' age groups and their death rate (X2=50.43; df=4; p<0.001). The mortality rate increased in direct proportion with age, with 44 (32.1%) and 92 (31.9%) values for patients aged 10-19 and 20-39, respectively.

The per cent TBSA burns in admitted patients ranged from 1-100%. Overall, the percentage of patients who had more than 60% TBSA burns was 183 (26.0%). Only two patients were reported to have multiple injuries with 100% TBSA

Table-4: Distribution of patients by causes of burn injuries, average length of stay and death rate.

Causes of Burns	Number of Hospitalised Patients		Length of Stay Mean Days, α=95%	Death Rates	
	N	%		N	%
Self-inflicted	101	14.3	4.7 (3.5-5.8)	77	76.2
Gas Explosion	165	23.4	4.6 (4.0-5.3)	30	19.0
Kerosene Heater	65	9.2	6.1 (4.8-7.5)	17	26.6
Electrical	24	3.4	4.7 (3.0-6.2)	1	0.5
Scald/Hot Water	180	25.5	3.4 (3.0-3.8)	9	5.1
Other causes	170	24.1	5.1 (4.3-5.9)	25	15.7
Total	705	100	4.6 (4.2-4.9)	159	23.5
P-value			**P<0.001**	**P<0.001**	

burn. However, percent TBSA burn was differed by the type of burn injuries: for example, 88 (87.1%) of intentional burns have had over 60% TBSA, whereas burns caused by hot water accounted for less than 40% TBSA in approximately 90% of patients (Table-3).

The mortality rate was 72.3% (n=133) among 184 patients admitted to the hospital with over 60% TBSA burned. Further analysis showed that death rate closely associated with per cent TBSA burned (X2=350.63; df=3; p<0.001). In our series, the mortality rate increased in direct proportion with per cent TBSA burnt.

Concerning the site or location of burns, 26.1% (n=186) patients had multiple injuries. Other sites most commonly involved were head and neck (n=181; 25.5%) followed by the whole body (n=138; 19.4%) and the lower extremities/limb (n=112; 15.8%).

The hospital average LoS ranged from 1-30 days with mean and median values of 3 and 4.5 days, respectively. The most frequent hospital stay occurred in the age group 10-19 years. On an average, patients were hospitalised for a period of 4.6±4.5 days (95% CI: 4.2-4.9). No statistically significant difference was found in the mean values of LoS in the various age groups (p= 0.16).

Overall a mortality rate was 23.5% among the patients. Serious burn injuries (n=65; 44.2%), co-morbidities (n=33; 22.5%), noso-comial (hospital-acquired) infections (n=28; 19.0%) were the most common causes of mortality.

Nonetheless, the patients' hospital stay and their mortality rate varied according to the causes or types of burns (p<0.05). The average LoSs for patients differed from 3.4 (in patients injured by hot water) to 6.1 (in patients injured by kerosene heater) days. The death rate also considerably varied from 0.5% in patients with electrical burns to 76.2% in patients with self-inflicted burns.

Significant differences existed between hospital average LoS among the different causes of burn injuries (p<0.001). Tukey's test showed that injury hospitalisation probably due to inappropriate use of kerosene heater was higher than injury hospitalisation caused by hot water (α=0.95; 6.1 vs 3.4 days). There was also a significant difference between patients' causes of burn injuries and their causes of death (X^2=200.42; df=5; p<0.001), whereby self-harm injuries accounted for the highest mortality rates (n=77; 76.2%).

Discussion

The study summarises the epidemiological characteristics of burn injuries at a single burn centre in the city of Zahedan during a two-year period. Despite continued efforts to prevent burn injuries, to reduce casualties to the minimum, and to increase safety, together with recent advances in the management of burn injuries, such injuries remain one of the leading causes of injury, morbidity and mortality worldwide, causing more than 5 million deaths each year or 16,000 deaths each day.[9] Over 90% of burn injuries, mainly fire-related, occur in low- and middle-income countries, areas that generally lack the necessary infrastructure to reduce the incidence and severity of burns.[2]

Many studies have reported that over 20% of burnt, hospitalised patients die in hospitals. The mortality rate is lower in children. It is noticeably more, up to 79%, in burn injuries caused by intentional self-inflicted burns.[4] In the current study, the overall mortality rate and hospital stays were 23.5% and 4.6 days, respectively. Few studies have reported complete and comparable data on burn-related deaths and hospitalisations in Iran. However, comparisons are added where such data exists. This disparity is probably attributed to a lower threshold for hospitalising a patient with burn injuries.

Similar to many studies,[10] this study showed that burn injuries were found more among males in all age groups (54.5% vs 45.5%), reflecting the strong influence of gender on the risk of injury. However, several studies have also reported a predominance of burnt females.[6,11]

Regarding the age groups, our study indicated that most injuries occurred in patients aged 20-39 years old, relatively higher than that in other parts of Iran.[12-14] The 20-39 age group represents the most productive sector of the population when people are more exposed to hazards of burn injuries, both intentionally or unintentionally, either at home or at work. Yet, policy-makers have mostly neglected to follow this up or have marginalised the underlying causes of many burn-related injuries.

Previous studies have revealed that burn injuries most commonly occur in young people with mean ages less than 25 years old.[4] However, the current study found that serious burns occured most often in older adults aged 20-39 years. While we found that the incidence of burn injuries was comparable to other findings among children, the incidence rate amongst patients aged 40 years old or more (i.e. 9.3%) was fairly lower than the other studies.[6] Yet, the burn injuries amongst children pose a huge socio-economic burden on communities.[15] Since scalds due to hot water accounted for the majority of burn injuries among this age group, it is recommended to develop preventive programmes, focussing mainly on the risks and hazards to which children are exposed in their everyday routine within a domestic environment. Parents, guardians and school teachers are the best groups who should be targeted for this purpose.

Regarding the causes of burns, the current study showed that males were more frequently affected by electrical injuries or scald/hot water (100% and 55.0%) than females. However, females are more susceptible to self-inflicted burns or injuries caused by kerosene heaters than males. Commonly, in developing countries burn injuries are most often caused by fire-related accidents in home environment. A large number of burns occurred at homes where they are mostly the women who tend to work with fires and stoves, especially for cooking.[4,6] Likewise, a noteworthy feature of this study is that gas- or oil-related fire injuries were more common among female than male patients. This is explained by the fact that culturally some women in this area choose to be housewives or have limited autonomy to engage in public or social activities by themselves. It is also likely that low level of literacy, flammability of women's local clothes and unsafe application/design of stove and heaters — being the main sources of cooking and heating — pose further burden on female injuries than males in the region.[16] Effort should be made to increase literacy rate amongst women, and to design and produce safe home and kitchen appliances for cooking, preparing food and heating.

An unpleasant aspect of domestic injuries in this study is women victims of self-inflicted burns. Contrary to previous research,[10] intentional self-harm was responsible for a considerable number of burn admissions in this area, ranging from 30.7% in males to as high as 69.3% of all burn admissions in females. Again, this issue may be explained by unmet needs of women such as their low level of knowledge and attitude, tribal issues, culture etc. Persistent self-inflicted injuries among females can signal deeper rifts in society that warrant broader examination and discussion.

The study findings revealed that in Zahedan most burn injuries are caused by flames (including kerosene and gas burns) and scalds, with the minority caused by exposure to chemicals or electricity, which is the same finding reported by other authors.[6,7,10,13,17] This is largely due to the fact that flammable liquids such as gas and kerosene are nearly the most frequently used domestic fuels in Iran.

Cross tabulation of age groups by causes of burns showed that while flames, electricity and self-inflicted injuries are the most common type of burns in adult patients aged 20-39 years ($p<0.001$), scalds are the primary cause of burns among the children aged less than 9 years ($p<0.001$). Similar studies have come to the same conclusion.[6,10,17] In addition, a significant difference existed between the cause of burn and the patients' gender ($p<0.001$). There were more women with self-inflicted injuries and flame-related burns versus more men injured by scalds, electricity and flames. The significant correlation between per cent TBSA burned and causes of burns ($p<0.001$) showed that TBSA over 60% in flame-burned patients compared with other types of burns such as scalds. Besides, TBSA over 60% and self-harm injuries accounted for the highest mortality rates in admitted patients ($p<0.001$). These findings suggest that flame and intentional injuries are two most important determinants of burn injuries, even though similar studies have pointed to flame as the mere determinant.[6]

Moreover, the study findings suggest that patients' age and gender are other important factors for determining burn injuries, where a higher number of deaths are associated with increasing age, and female patients. The higher mortality rate in females can be explained by their tendency towards more attempted suicides than males. Panjeshahin et al.[6] came to the same conclusion. Cultural deficiency and socioeconomic deprivation together with easy access to inflammable materials would possibly contribute to the high frequency of self-inflicted burns in females.[10] Understanding the motive behind self-inflicted burns is vital if policy-makers' intervention is to be made successful.

Conclusion

Burn-related injuries are an important public health issue in the city of Zahedan, being one of the leading causes of death. The findings propose that the pattern of burns is similar to other Iranian cities, and that the mortality rate is fairly high. Deliberate self-inflicted burns appear to be a common method of suicide amongst women in this region. Increases in per cent TBSA burned over 60%, age older than 20 years, intentional self-inflicted burns, female gender, and flame and scald burns would largely contribute to a high mortality rate in hospitalised patients. The epidemiologic profile of burn injury patients in this area should be used to develop and implement a quality burn prevention programme with a focus on high-risk groups such as females and people aged 20-39 years old. Policy-makers are required to educate the public about potential burn risks and how to avoid them, and to regulate the safety of products, if they are to prevent burn-related injuries.

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